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Vaccination-Related Activities at Schools With Kindergartners: Evidence From a School Nurse Survey

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Abstract

Vaccination coverage among children in kindergarten varies across the country and within states. We surveyed a convenience sample of kindergarten school nurses to investigate self-reported vaccination-related activities conducted at schools nationwide. The majority of the 1,435 kindergarten school nurses responding reported that their schools communicate with parents and guardians of undervaccinated students by phone (96%), postal mail (67%), newsletters (61%), and e-mail (59%). Most respondents reported documenting vaccination coverage in electronic systems (85%) and sharing coverage reports with health departments (69%). A total of 41% of school nurses worked with external partners for vaccination efforts, the most common support received from partners being vaccine administration (38%) and providing materials/vaccines (21%). School nurses also reported that 95% of kindergartners were up to date for all vaccines. School-based

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Author Contributions

All authors contributed to the acquisition and analysis of data presented in this manuscript, were involved in the process of its critical revisions, and also gave the final approval on the manuscript. The first draft of the manuscript was prepared by A. J. Leidner and J. M. Underwood. All agree to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interests

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Authors' Note

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

vaccination-related activities are essential to sustaining high levels of vaccination coverage for the protection of children at schools and in the broader community.

Keywords

vaccines; immunization; schools; school nurse

Substantial health and economic benefits accrue to individuals and society from immunizations against vaccine-preventable diseases (Messonnier, Corso, Teutsch, Haddix, & Harris, 1999; Rappuoli, Miller, & Falkow, 2002; Whitney, Zhou, Singleton, & Schuchat, 2014). One study has estimated that the U.S. childhood vaccination schedule generates net savings of \$10–43 billion over the lifetimes of a birth cohort of 3.8 million vaccinated children (Zhou et al., 2005). In 2017, the Centers for Disease Control and Prevention (CDC) reported substantial variability in vaccination coverage and exemptions among kindergarteners across the United States: State-level vaccination coverage estimates ranged from 86.9% to 99.2% for measles, mumps, and rubella (MMR) vaccine and from 84.3% to 99.6% for diphtheria, tetanus, and acellular pertussis (DTaP) vaccine (Seither et al., 2015). School-level immunization efforts, such as monitoring and enforcement of state vaccination requirements for school entry, can play a critical role in maintaining high vaccination coverage (Orenstein & Hinman, 1999; Smith et al., 2017).

Achieving greater levels of vaccination coverage in schools is especially important because locally clustered areas of undervaccination have led to outbreaks of vaccine-preventable disease (Feikin et al., 2000; Omer et al., 2008; Phadke, Bednarczyk, Salmon, & Omer, 2016). In addition, differences among states in vaccination exemption policies, which can be related to overall vaccination coverage, are associated with incidence of vaccine-preventable diseases (Bradford & Mandich, 2015). While recent research has suggested that specific school-based activities such as vaccination promotion (Swallow & Roberts, 2016) and vaccination clinics (Peterson et al., 2012) may lead to increased vaccination coverage rates, the extent to which these activities occur in schools across the country is not well understood. The objective of this study was to gain an understanding of the types of school-level vaccination activities that occur at schools, with an interest in better understanding factors that may contribute to differences in vaccination coverage, clusters of undervaccinated students, and with implications for parental and community attitudes about vaccinations.

Background

Approximately 132,000 school nurses serve more than 50 million students across approximately 98,000 elementary and secondary schools in the United States (Glander, 2017; Willgerodt, Brock, & Maughan, 2018). The majority of school nurses work in urban areas (93%), at public schools (78%), and in elementary schools (67%). Approximately 89% of elementary schools sampled in a recent study reported having some kind of paid or volunteer nursing support (Willgerodt et al., 2018). Of the schools with nursing support, the majority of school nurses (98%) reported working with immunization and compliance activities, while a much smaller percentage of school nurses (18%) reported administering

vaccinations (Willgerodt et al., 2018). In 2015, the National Association of School Nurses (NASN) surveyed a sample of over 8,000 school nurses (Mangena & Maughan, 2015) and found that the average school nurse is between 47 and 55 years old, has 31 years of experience as a nurse and 19 years of experience as a school nurse, and serves approximately 1,000 students. The student population served by a nurse varies substantially across U.S. regions: Between 588 and 849 students are served by most nurses from northeastern states and between 1,351 and 1,685 students are served by most nurses from western states (Mangena & Maughan, 2015).

Recent high-profile outbreaks of vaccine-preventable diseases have occurred in geographically clustered areas that have high rates of undervaccinated children (Gahr et al., 2014; Nelson, 2019; Slade, Klekamp, Rico, & Mejia-Echeverry, 2014; Sugerman et al., 2010). Outbreaks like these have led to substantial costs for families, communities, and the public health system (Sugerman et al., 2010). Researchers have found that school nurses have a positive effect on student health and health education outcomes (Baisch, Lundeen, & Murphy, 2011; Best, Oppewal, & Travers, 2018; Lineberry & Ickes, 2015). Students attending schools with school nurses appear to be less likely to have a vaccine exemption (Salmon et al., 2004). A study in Vermont found that school nurses play a critical role in documenting and managing immunization and provisional enrollment status of students who have not met all school entry vaccination requirements but are granted temporary approval to attend school (Davis, Varni, Barry, Frankowski, & Harder, 2016).

Method

Data Collection

NASN and CDC developed a school-level immunization practices questionnaire to survey a convenience sample of kindergarten school nurses across the United States. The survey questions were initially developed by the authors. Survey questions were then shared and tested among a small group of subject matter experts from NASN and from the Immunization Services Division of the National Center for Immunization and Respiratory Diseases of CDC. Based on feedback, the survey questions were revised for clarity, readability, and relevance. Where possible, survey responses were made to be multiple choice with the option to specify “Other” and write in an additional response that was not included in the set of multiple choice options. For questions where possible responses included a large variety of numerical values, a write-in format was used (e.g., “What percent of kindergarten students were up to date.... with all of their required vaccines?”).

A link to the survey was sent via e-mail to approximately 17,000 NASN members and included in a weekly electronic newsletter distributed to NASN members and nonmembers. Contacts within state immunization programs were also provided the survey link and asked to distribute to school nurses in their states. The survey was administered online from October 24 through November 14, 2017. The survey protocols and questionnaire were approved by CDC and determined exempt from human subjects review.

The survey collected information related to school nurses’ background and numbers of schools and students served. Since many respondents served multiple schools, for some

questions, respondents were asked to consider a representative school within their service area that enrolls kindergarten students. Referring to that representative school, respondents were asked about immunization activities, nonschool system partners who assist in immunization activities, and vaccination coverage rates at the school. The questions related to immunization activities elicited activities conducted at schools by the school nurse or other school staff. For vaccination coverage rates, survey respondents were asked to refer to the official immunization report for the 2016–2017 school year for the representative school. The survey collected vaccination coverage rates related to MMR vaccine, DTaP vaccine, and other vaccines required for kindergarteners that can vary across states.

Analysis

For questions on the number of years a respondent has been a nurse, the extreme low and high values were not standard numeric values. The options “less than 1 year” and “25 years or more” were recoded as 0.5 and 25 years, respectively. Survey responses were tabulated, checked for quality, and analyzed using R statistical software (version 3.4.2). Frequencies were calculated for demographic information related to school nurse characteristics and characteristics of the representative school. Mean, standard deviation, median, and interquartile range (IQR) for school nurse and school characteristics (e.g., number of kindergarten students served, years of experience as a school nurse, and self-reported vaccination coverage rates of MMR, DTaP, and all required vaccines) were calculated. Vaccination coverage rate estimates were stratified into two groups by school type. Traditional public and charter schools were grouped together. Private and parochial schools were grouped together. For states with sufficient sample size (i.e., 30 or more responses), we estimated state-level, self-reported vaccination coverage rates.

Results

The survey was attempted by 2,182 nurses working in schools with a kindergarten (henceforth, “kindergarten school nurses”). Of those, 603 were excluded due to incomplete responses, and 144 were excluded because the responses were in the lowest 1% of coverage estimates reported or they were logically inconsistent. The majority of observations in the lowest 1% of coverage estimates appeared to be *errors* or invalid entries. Logically inconsistent coverage estimates, as one example, included observations that reported coverage for all required vaccines that exceeded the reported coverage of either MMR or DTaP. The final sample included 1,435 school nurses from all 50 states and the District of Columbia.

The school nurses in our sample served an average of 1,207 (median = 537, IQR = 360–901) total students from any grade level (Table 1). About 34% of school nurses worked at more than one school (mean = 2.3, median = 1, IQR = 1–2). The majority of respondents reported more than 10 years of school nurse experience (mean = 11.3, median = 10, IQR = 4–17). The mean number of years working outside a school setting was 12.5 (median = 13, IQR = 6–20). The average number of kindergarten students attending each school from the representative schools in our sample was 87.0 (median = 66, IQR = 39–98).

Immunization Activities and Partners

Table 2 contains a full list of immunization-related activities that were conducted in the 12 months prior to the survey. Commonly reported immunization-related activities conducted by school staff related to contacting parents or guardians of undervaccinated students (by phone [96% of respondents], postal mail [67%], and e-mail [59%]), documenting data in an electronic system (85%), sending immunization records to health departments (69%), and providing information in newsletters (61%). Fourteen percent of respondents reported that they administered vaccinations at school-based clinics. While 85% of respondents reported documenting data in an electronic system, a smaller percentage (32%) reported documenting data in a statewide immunization information system (IIS).

Forty-one percent of school nurses reported that their representative school worked with any kind of nonschool system partner. Thirty-four percent of respondents reported partnerships with public health districts or health departments, and 15% reporting partnerships with community immunization clinics. Few respondents reported school partnerships with parent groups (1%) or the pharmaceutical industry (1%). The most commonly reported types of support received from partnerships included vaccine administration (38%) and materials or vaccines (21%; Table 2).

Vaccination Coverage

The self-reported vaccination coverage rates for MMR and DTaP were similar to each other and were also similar across different types of schools. The mean coverage rate for MMR was 96.3% (median = 100, IQR = 97–100) among all schools, 96.3% (median = 99.0, IQR = 97–100) among public and charter schools, and 96.4% (median = 100, IQR = 97–100) among private and parochial schools (Table 3). Self-reported vaccination coverage rates for 9 states with 30 or more respondents (Arkansas, California, Massachusetts, New Jersey, New York, Ohio, South Carolina, Tennessee, and Texas) ranged from 93.1% to 99.3% for MMR, from 93.2% to 99.0% for DTaP, and from 91.9% to 98.4% for all required vaccines (Table 4).

Discussion

Our results suggest that kindergarten school nurses are engaged in a variety of communication activities that support important, vaccination-related public health objectives. In addition, previous studies have found communication and education interventions are important activities in the effort to improve adherence to vaccination requirements and increase vaccination coverage. Telephone and postal mail reminders are known to promote vaccine uptake in early childhood populations (Harvey, Reissland, & Mason, 2015). These reminders may be especially effective given school nurses' status as opinion leaders on student health issues (Rosen, Goodson, Thompson, & Wilson, 2015).

The average, absolute value difference between state-level MMR and DTaP coverage rates reported here and estimates from the CDC school vaccination coverage assessment is 1.9%. Each year, CDC leads an effort to estimate vaccination coverage among kindergartners across the United States (Seither et al., 2017). In both the CDC assessment and in our study,

reported vaccination coverage among kindergartens is high, underscoring the important role school nurses play in monitoring and enforcing adherence to the requirements. While overall vaccination coverage rates were high in both the CDC assessment and in this study, differences in vaccination coverage across states were observed in both. These differences could be due to differences in allowable exemptions, differences in laws related to allowance of grace periods and provisional enrollment for students not fully vaccinated, and differences in vaccination activities, like those reported on in our study, across geographic locations. Differences were also observed between the CDC assessment and this study, which are likely related to different sampling and methodological approaches. In particular, this study collected vaccination coverage estimates from a convenience sample of schools including kindergartners that have school nurses. By contrast, the CDC assessment collects coverage estimates from federally funded immunization programs, each of which can utilize different methodologies to calculate coverage rates such as census, stratified sampling, voluntary responses, or a mixture of methods.

The *Framework for 21st Century School Nursing Practice* discusses addressing population-based health measures and the importance of working with interdisciplinary teams (NASN, 2016). In the current study, a majority of respondents indicated that their representative school had not worked with external partners to achieve immunization goals. A recent review concludes that school vaccination programs are effective and feasible interventions to improve vaccination coverage among children and adolescents (Cawley, Hull, & Rousculp, 2010). Additional evidence indicates that school-based clinics can effectively increase vaccination coverage and prevent disease (King et al., 2006) and, in some cases, can potentially reduce student absenteeism (Hull & Ambrose, 2011; Wiggs-Stayner et al., 2006). However, only 14% of school nurses reported that student vaccinations were administered at clinics in their representative school and only 38% reported vaccine administration as a type of partnership support, which could have been provided at the location of the school or a school partner. Overall, these findings suggest that additional opportunities exist for external partnerships to assist schools with their immunization goals. While our study has focused on vaccinations related to kindergarten students, information about the most effective immunization activities could potentially be applied to school nurse activities that are targeted toward older students. For human papillomavirus vaccinations, one recent study suggests that a better understanding of school nurse immunization activities could lead to greater vaccination coverage (Bartlett & Peterson, 2011) and, in particular, another study suggests that communications from the school nurse as a potentially important mechanism to increase coverage (Rosen et al., 2015).

Limitations

This study is subject to at least three limitations. First, this study collected self-reported information, so caution is warranted when generalizing these results due to potential recall bias. Second, participants represent a convenience sample recruited through professional organizational networks. As such, the sample may not reflect patterns across all school-based nurses in the United States and may not reflect patterns across all schools in the United States, a portion of which may not have a school nurse. However, state-level estimates of vaccination coverage from this survey appear to be similar to those reported in

the annual CDC kindergarten vaccination coverage assessment. Third, our survey requested that school nurses consider a representative school in some of their responses, but we were unable to assess the representativeness of the schools the respondents chose, relative to all the schools they work with, or to the schools captured in our sample. Finally, our survey questions investigated immunization activities conducted at schools by school nurses or other school staff, so the activities reported for this question may not represent the activities of school nurses in isolation but instead the activities of school nurses, administrative staff, and the team of professionals at schools who work on immunization efforts. Despite these limitations, this study contains key strengths. Nearly 1,500 school nurses participated in the survey, with respondents from all 50 states and Washington, DC. Response rates to surveys distributed by e-mail have been declining for many years (Sheehan, 2001), and response rates of 10% or less for similar types of surveys are not uncommon (Van Mol, 2017). The demographic age of school nurse participants and the number of schools they cover is consistent with other workforce studies of school nurses (Willgerodt et al., 2018). This study represents the most up-to-date inventory of vaccination activities conducted at schools with the help of school nurses across the United States.

School Nursing Implications

One of the many responsibilities of school nurses is to ensure compliance with state immunization laws. In a recent study (Smith et al., 2017), the vaccination coverage gap was identified as the percentage of students who are undervaccinated relative to school entry vaccination requirements but have not requested or utilized an exemption. For measles-containing vaccines, this gap was found to be equal to 7.7%. Students in the vaccination coverage gap present an opportunity to increase vaccination coverage rates among individuals who do not appear to be eligible for or interested in acquiring vaccine exemptions. The results of the current study demonstrate the opportunities that exist for school nurses to proactively engage with parents regarding questions of compliance. Another study (Swallow & Roberts, 2016) found contacting parents first by letter, with follow-up e-mails or phone calls, was effective in increasing vaccination compliance. In these communications, the school nurses provided information on the relevant vaccination policies as well as vaccination clinics in the area. Other researchers have found enforcing laws related to school exclusion for noncompliance and providing education to parents improved compliance (Hall, Howell, Jansen, & Carson, 2017).

An important part of vaccination compliance involves tracking records. Updating and maintaining immunization records, especially among students moving across state boundaries, can be time-consuming and tedious (Hall et al., 2016). The majority of school nurses in our sample (85%) reported using electronic systems to track documentation. However, only 32% reported using the state IIS. The types of laws, regulations, and policies that govern how data can be shared and exchanged from a state IIS can be diverse across states (Martin, Lowery, Brand, Gold, & Horlick, 2015).

Our assessment of school-based immunization practices reported by a sample of school nurses helps to document the usage of interventions designed to improve public health outcomes and identify interventions that can be more widely utilized. Our findings provide

new and relevant information about school nurses and the school environment as they relate to school entry vaccination policy adherence and immunization activities.

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Table 1.

Characteristics and Demographics of School Nurses and Schools, Fall 2017.

School Nurses	Mean	SD	Median	Interquartile Range
Number of schools served	2.3	6.5	1	1–2
Number of students served	1,207	4,484	537	360–901
Number of kindergartners served in the nurse's representative school ^a	87.0	175.4	66	39–98
Years of experience as a school nurse ^b	11.3	7.6	10	4–17
Years of experience as a nurse in a nonschool setting ^b	12.5	7.1	13	6–20

Note. *N* = 1,435.

^a Nurses who work at more than one school were asked to choose one representative school and answer on behalf of that one school.

^b In the survey, the lowest and highest option for years of experience as a school nurse were “less than 1 year” and “25 years or more,” which were converted to 0.5 and 25, respectively, for this table. Similarly, the extreme values for years of experience in a nonschool setting were “less than 1 year” and “more than 20 years,” which were converted to 0.5 and 21, respectively, for this table.

Table 2.

Frequency of Responses Related to Immunization Activities, Partnerships, and Partnership Support From a Survey of School Nurses, Fall 2017.

	% ^a
Immunization Activity Conducted by School Staff in the Previous 12 Months	
Made phone calls to parents/guardians of undervaccinated students	96
Documented immunization data in any electronic system	85
Sent immunization reports to local and/or state health departments	69
Sent postal mail to parents/guardians of undervaccinated students	67
Provided information in school newsletters or other similar outlets	61
Sent e-mail to parents/guardians of undervaccinated students	59
Excluded student from school because he or she was not vaccinated	43
Partnered with local clinics to receive/distribute vaccines or educational materials about vaccines	40
Documented immunization data in the state-wide immunization information system	32
Participated in health department immunization audits	28
Vaccinated enrolled students at the school-located or school-based immunization clinic	14
Visited parents/guardians/families at home to discuss immunizations or to vaccinate students	6
Conducted inventory, monitored, or managed supplies of vaccines kept in storage	2
Ordered and/or purchased vaccines to administer to students	2
Our staff does not conduct any of the immunization-related listed activities	1
Other	3
Types of immunization activity partners ^a	
Any partners ^b	41
Public health district or health department partners	34
Community immunization clinics	15
Private health services partners	9
Community nursing services/School-linked health center	6
Pharmaceutical industry partners	1
Parent groups	1
Other	2
None	59
Types of activities or support received from partnerships ^{a,c}	
Vaccine administration	38
Materials/vaccines	21
Marketing/communication	8
Financial support	5
Other	3

Note. N = 1,435.

^aPercentages do not sum to 100% because respondents were allowed to select as many options as were applicable.

^b“Any partners” indicates that at least one of the options for types of partnerships was selected, therefore 59% of respondents did not report any type of partnership.

^cPercentages reflect all respondents, not just the respondents who reported having some type of partnerships.

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Table 3.

Vaccination Coverage for MMR, DTaP, and All Required Vaccines for the 2016–2017 School Year Among Kindergarteners in Self-Reported Data^a From a Survey of School Nurses in Fall 2017.

School Type	Vaccine Type	Mean	SD	Median	Interquartile Range	N
All schools	MMR	96.3	10.5	100.0	97–100	1,435
	DTaP	96.3	10.5	100.0	97–100	
	All vaccines ^b	95.0	12.3	99.0	95–100	
Public/charter schools	MMR	96.3	10.4	99.0	97–100	1,249
	DTaP	96.3	10.3	99.0	97–100	
	All vaccines ^b	95.0	12.4	99.0	95–100	
Private/parochial schools	MMR	96.4	11.3	100.0	97–100	186
	DTaP	96.4	11.3	100.0	97–100	
	All vaccines ^b	95.6	11.6	100.0	95–100	

Note. MMR = measles, mumps, and rubella vaccine; DTaP = diphtheria, tetanus and acellular pertussis vaccine.

^a Inconsistent coverage rates and the lowest 1% of survey coverage reports were excluded from analysis.

^b Respondents were asked what percentage of kindergarten students were up to date “with all of their required vaccines,” which refers to additional vaccines beyond MMR and DTaP, depending on state.

Table 4.

Selected State-Level Vaccination Coverage Levels for the 2016–2017 School Year Among Kindergarteners in Self-Reported Data^a From a Survey of School Nurses in Fall 2017.

State	MMR			DTaP			All Vaccines ^b		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Arkansas	95.3	7.3	37	95.9	7.1	37	94.6	7.9	37
California	97.6	4.2	47	97.1	4.4	47	96.3	5.5	47
Massachusetts	99.3	1.2	37	99.0	2.1	37	98.4	2.3	37
New Jersey	94.5	15.2	64	95.3	14.2	64	93.6	17.0	64
New York	98.0	7.5	236	97.8	7.8	236	96.6	10.2	236
Ohio	94.6	13.0	51	94.5	13.0	51	91.9	18.1	51
South Carolina	93.1	15.2	44	93.2	15.2	44	93.0	15.1	44
Tennessee	97.4	7.2	50	97.3	8.4	50	96.1	10.8	50
Texas	98.3	8.1	142	98.2	7.9	142	97.0	11.0	142

Note. MMR = measles, mumps, and rubella vaccine; DTaP = diphtheria, tetanus and acellular pertussis vaccine.

^aInconsistent coverage rates and the lowest 1% of survey coverage reports were excluded from analysis.

^bRespondents were asked what percentage of kindergarten students were up to date “with all of their required vaccines,” which refers to additional vaccines beyond MMR and DTaP, depending on state.